What is physics?

Physics is the study of nature and its laws. Since physics is study of nature, it is real. No one has the authority to frame rules of physics. We only discover the rules that are operating in nature. Description of nature becomes easy if we have the freedom to use mathematics. Mathematics is the language of physics. Without knowledge of mathematics it would be difficult to discover, understand and explain laws ofnature.

Since physics describes laws of nature. This description is quantitative and involves measurement and comparison of physical quantities. To measure a physical quantity we need some standard unit of that quantity.

FUNDAMENTAL AND DERIVED UNITS

There are a large number of physical quantities which are measured and every quantity needs a definition of unit. However, not all quantities are independent on each other. So we define a set of fundamental quantities asfollows:

(a) the fundamental quantities should be independent of eachother
(b) all other quantities may be expressed in terms of the fundamental quantities.

It turns out that the number of fundamental quantities is seven. All the rest may be derived from these seven quantities by multiplication and division. Fundamental quantities are also called as base quantities.

Quantity	Name of the unit	Symbol
Length	metre	m
Mass	Kilogram	Kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	Kelvin	K
Amount of substance	Mole	mol
Luminous intensity	candela	Cd

Rest:

When a body does not change its position with respect to time and its surroundings, the body is said to be at rest. For example, if a chair is placed in the middle of a room, then the walls of the room are its surroundings. If the position of the chair (i.e. its distances from the walls) does not change with respect to the walls as well as time, then the chair is atrest.

Motion:

When the position of a body continuously changes with respect to time and its surroundings, the body is said to be in motion.
In other words, when the position of a body continuously changes with respect to the reference point and time (any stationary object around the body), the body is said to be in a state of motion.

Motion is a relative term:

When we say that a body or an object is in motion, then it is essential to see whether the body or object changes its position with respect to other bodies or objects around it or with respect to any fixed point known as reference point. For example, when a bus moves on a road, then the bus as well as the passengers sitting in it change their positions with respect to a person standing on the road side. However, the passengers sitting in the bus do not change their positions with respect to each other. It means, the passengers sitting in a moving bus are not in motion with respect to each other. We find that an object is in motion only if it changes its position (or mover) with respect to a fixed point or a fixed body. Therefore, a body air an object is in motion with respect to one thing but the same body or an object may not be in motion with respect to another thing. Thus, motion is a relativeterm.

Distance: It is the actual length of the path traveled by a moving body irrespective of the direction in which the bodymoves.

Units of distance: In S.I. system, unit of the distance is metre (*m*). However, for distance more than 1000m, we use a bigger unit called kilometer (*km*).

Displacement: The shortest distance of a moving body from the point of reference (*initial position of body*), ina specified direction is called the displacement.

Units of displacement: It has the same units as the distance except that the direction is alsospecified.

DIFFERENCES BETWEEN DISTANCE & DISPLACEMENT

Distance	Displacement
1. *It is the actual length of the path traveled by a movingobject.* 2. *The direction need not bespecified.*	1. *It is the shortest distance between the initial position (point of origin) and the final position of theobject.* 2. *The direction has to be specified with respect to the reference line.*
3. *The distance covered indifferent directions can be added by simple arithmetic.*	3. *The displacements indifferent directions can not be added by simple arithmetic.*
4. *The distance covered by amoving object cannot be zero.*	4. *The displacement of a movingobject can be zero.*

Scalar Quantities

The physical quantities which are completely described by the magnitude only are called scalar quantities.

Examples of scalar quantities: Physical quantities such as mass, length, area, volume, distance, speed, work, energy, power, temperature, pressure, electric charge, electric potential etc. scalar quantities.

Characteristics of scalar quantities:

(i). They can be completely described by magnitudealone.
(ii). They can be added by simple arithmetic. For example, the total mass of 5 kg of sugar and 5 kg of salt is 10kg.
(iii). They cannot be plotted on a graph it is because they are not represented by any direction. Thus, we do not know whether they should be taken on X-axis orY-axis.

Vector Quantities

The physical quantities which are completely described only if their magnitudes and directions are specified are called vector quantities.

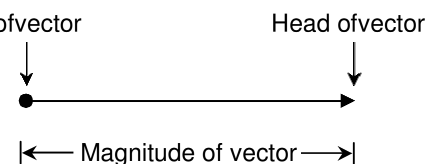
Examples of vector quantities: Physical quantities such as displacement, velocity, acceleration, retardation momentum, force, moment of a force weight, electric intensity, magnetic intensity etc., are vectorquantities.

Characteristics of vector quantities:

(i). They can be completely described only by specifying the magnitude as well asdirection.
(ii). They cannot be added by simple arithmetic. For example, a displacement vector of 3 *m* towards east and 4 *m* towards north cannot be 7 *m* towards north of east. Instead it is 5 *m* at an angle of 53^o, north ofeast.
(iii). They can be represented on graph as their direction isspecified.

Graphical Representation of Vectors

The representation of vectors by line diagram is called graphic representation of vectors.

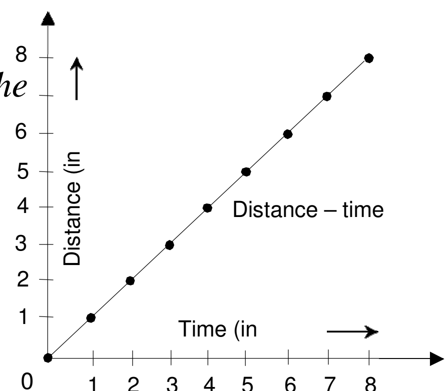


A vector quantity is completely represented by a straight line with an arrow head, such that the length of the line represents the magnitude of the vector and the arrow head represents the direction of the vector.

The tip of the arrow head of the victor, represented by a straight line is called the head of the vector. The end point of the straight line representing of the vector, is called the tail of thevector.

UNIFORM MOTION

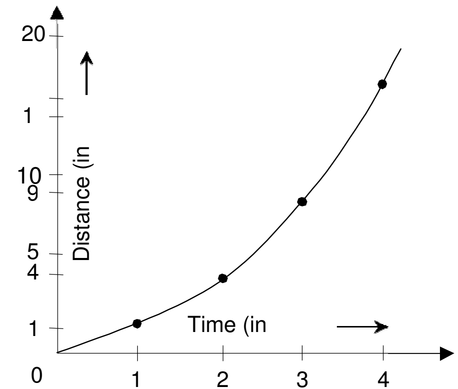
When a body covers equal distances in equal intervals of time, however small may be time intervals, the body is said to describe uniformmotion.



Characteristics ofuniformmotion

(i) The moving body covers equal distances in equal intervals of time, however small thetimeintervals may be.
(ii) The graph between the distance covered and the time, is a straightline.
(iii) The motion is non-accelerated innature.

NON – UNIFORM MOTION



When a body covers unequal distances in equal 16 *intervals of time, it is said to be moving with a non-uniformmotion.*

Characteristics of non-uniform motion

(i) The body does not cover equal distances in equal intervals oftime.
(ii) The graph line between distance and the time is always acurve.
(iii) The motion is accelerated in nature.

SPEED

Speed of an object is defined as the distance travelled by it per unit time.

<u>Mathematical expression for speed:</u>

If a body travels a distance *S* in time *t*, then

In time t, the distance traveled = S

∴ In time 1 second, the distance traveled = $\frac{S}{t}$

or, the distance traveled in unit time = $\frac{S}{t}$

But the distance traveled in unit time is called the speed.

∴ Speed= $\frac{S}{t} = \frac{\text{Distance covered by the body}}{\text{Timetaken}}$

Units of speed

In S.I system, the unit of speed is metre per second (*m/s*). For measuring larger speeds, the unit is kilometer per hour (*km/hr*). Speed is a scalar quantity. It is because it has the magnitude, but nodirection.

UNIFORM SPEED

When a body covers equal distances in equal intervals of time, however small the intervals may be, the body is said to be moving with uniform speed.

VARIABLE SPEED OR NON-UNIFORM SPEED

When a body covers unequal distances in equal intervals of time, the body is said to be moving with variable speed or non-uniform Speed.

AVERAGE SPEED

The average distance covered by a moving body per unit time, when the body is moving with a variable speed, is called average speed.

Or

The quotient of the total distance traveled by a body divided by the total time taken by the body to cover the distance is called its average speed.

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

VELOCITY

The distance covered by a body per unit time in a specified direction is called thevelocity.

Or

The speed of a body ina specified direction is called the velocity. Thus, mathematically:

$$\text{Velocity} = \frac{\text{Distance travelled in a specified direction}}{\text{Time taken to travel the distance}}$$

If 'v' is the velocity, 'S' the distance in a specified direction and 't' the time required to travel the distance, then

$$v = \frac{S}{t}$$

Units of Velocity

The units of velocity are the same as speed. Thus, in S.I. system its unit is *m/s*. However, a larger unit such as *km/hr*is also used.

KINDS OF VELOCITY

(A) UNIFORMVELOCITY

When a body covers equal distances in equal intervals of time (however small the time intervals maybe) in a specified direction, the body is said to be moving with uniform velocity.

Conditions for uniform velocity

(i). The body must cover equal distances in equal intervals of time.
(ii). The direction of motion of the body should not change.

(B) VARIABLE VELOCITY OR NON UNIFORMVELOCITY

When a body covers unequal distances in equal intervals of time in a specified directions or when a body covers equal distances in equal intervals of time, but its direction changes, then the body is said to be moving with variable velocity.

Differences between speed and velocity

Speed	Velocity
1. The distance covered per unit time is calledspeed. *2. It is a scalarquantity.*	*1. The distance covered per unit time in a specified direction is called velocity.* *2. It is a vectorquantity.*
3. Average speed of a movingobject cannot be zero.	*3. Average velocity of a movingobject can be zero.*
4. Speed tells how fast an objectmoves. *5. Speed is a scalarquantity.*	*4. Velocity tells how fast an object moves and in which direction it moves.* *5. Velocity is a vectorquantity.*

ACCELERATION

The rate of change of velocity of a moving body is called acceleration.

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time}}$$

Acceleration is a vector quantity.

Expression for acceleration

Let the velocity of an object at time (t =0) =u (known as initial velocity)

And the velocity of an object at time (=t) = v (known as final velocity)

Then change in velocity of the object = v – u

Time taken for this change in velocity =t – 0 = t

Now, acceleration of the object = $\frac{\text{Change in velocity}}{\text{Time}}$

$$= \frac{\text{Final velocity} - \text{Initial velocity}}{\text{Time taken}}$$

Therefore, *Acceleration,* $a = \frac{v-u}{t}$

Positive acceleration

The rate of change of velocity of a moving body, when the velocity is INCREASING is called positive acceleration only and is denoted by'a'.

Negative acceleration (Retardation)

The rate of change of velocity of a moving body, when the velocity is DECREASING is called negative acceleration and is denoted by '− a'.

Negative acceleration is commonly referred to as retardation or de-acceleration ordeceleration.

Units of acceleration

The unit of acceleration must have the unit of ***length*** and ***square of time***. ***In S. I system***, the unit of acceleration in ***m/s***^{2}.

UNIFORM ACCELERATION

When a body undergoes equal changes in velocity in equal intervals of time (however small the time intervals may be), the body is said to be moving with uniform acceleration.

Example:-i) The motion of an object falling freely form the top of a building.

ii) The motion of a ball rolling down a smooth inclined plane.

NON-UNIFORM ACCELERATION OR VARIABLE ACCELERATION

When a body describes unequal changes in velocity in equal intervals of time, the body is said to be moving with non-uniform acceleration.

A body moving with a variable velocity has non-uniform acceleration. For example, a car moving on a busy road has a non-uniform acceleration.

Example:-i) The motion of a bus leaving or entering the bus stop.

ii) The motion of a train leaving or entering the platform.

DISTANCE-TIME GRAPHS

Distance-time graph shows how the distance of a body from a fixed point changes with time. To draw distance-time graph, distance travelled by the body is plotted along Y-0axis and the time taken by the body to travel this distance is plotted alongX-axis.

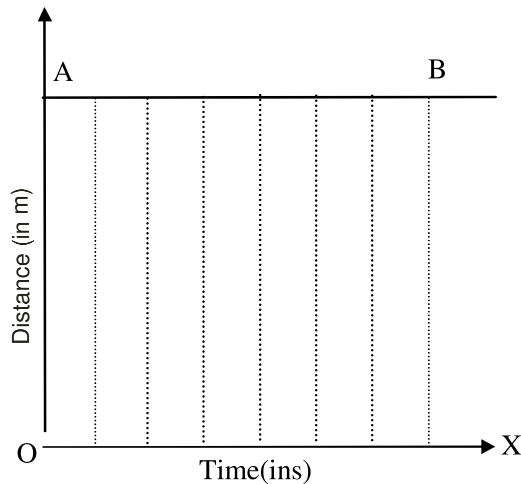
DISTANCE-TIME GRAPHS FOR A STATIONARY BODY

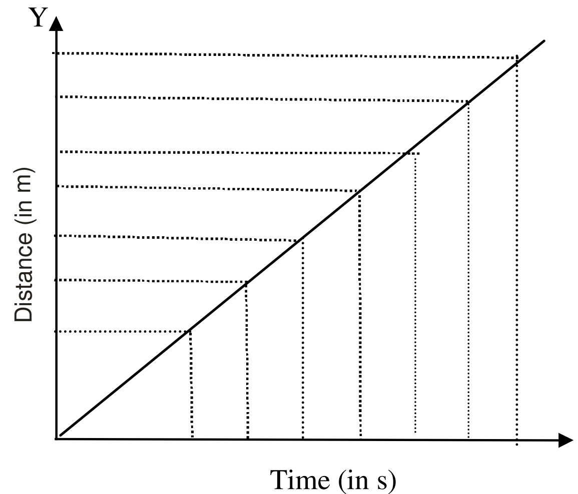
The distance of a stationary body from a fixed point does not change with the passage of time. It means, if the distance of a stationary body from a fixed point (say O) is 4 m at time t = 0, then the distance of this body will remain 4 m for all times.

Distance-time graph for a stationary body is a straight line (AB) parallel to time-axis.

DISTANCE-TIME GRAPHS FOR UNIFORM MOTION

If a body travels equal distances in equal intervals of time, then the motion of the body isknownasuniformmotion.





Distance-time graph for the uniform motion of a body is a straight line having a constant angle with the time-axis or constant gradient or slope.

CALCULATION OF THE SPEED OF A BODY

The speed of a body having uniform motion is constant throughout the motion.

We know, Speed = $\frac{\text{Distancetravelled}}{\text{Time taken to travel this distance}}$

To calculate the speed of the body from a distance-time graph, choose any two points say A and B on the straight line. From points A and B, draw perpendiculars AE and BCrespectively on time axis. Now draw a perpendicular AD onBC.

The distance travelled by the body in going from point A to B

$= \Delta x = BC - CD$

$= S_2 - S_1$

Time taken by the body to cover this distance = Δt

$= t_2 - t_1$

Therefore, Speed =

Hence = Slope of distance-timegraph.

Therefore speed of a body = Slope of distance-time graph.

DISTANCE-TIME GRAPHS FOR NON-UNIFORM MOTION

If a body travels unequal distances in equal intervals of time, then the motion of the body is known as non-uniform motion.

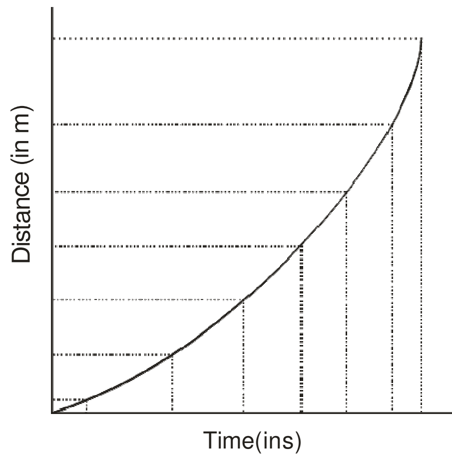
Non-uniform motion of a body is of two types:

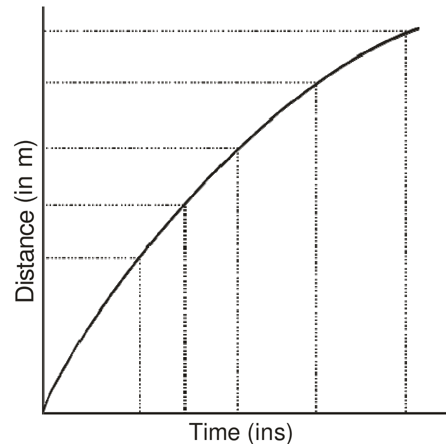
1. When the speed of the body increases with passage of time: For example, when a train leaves the platform, its speed increases with passage of time. That is, the train covers more and more distance in unittime.

Distance-time graph for the non-uniform motion of a body is a curve having increasing slope of gradient.

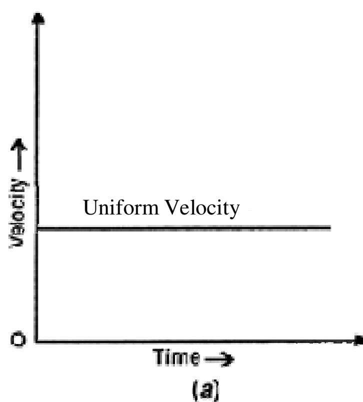
2. When the speed of the body decreases with passage of time: For example, when a train approaches the platform, its speed decreases with the passage of time. That is, the train covers less and less distance in unittime.

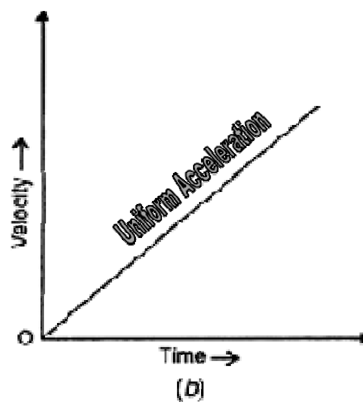
Distance-time graph for the decreasing non-uniform motion of a body is a curve having decreasing slope. That is, the speed of the body decreases with passage of time.

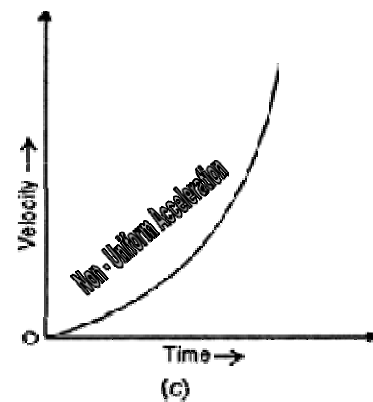




VELOCITY-TIME GRAPHS







In these graphs, the velocity is plotted on Y-axis and time on X-axis. The slope of the velocity-time graph gives acceleration. It is because:

$$Acceleration = \frac{Changein\ velocity}{Time}$$

The acceleration will be positive if the slope of the graph is positive and negative if the slope of the graph is negative.

The area enclosed under the velocity-time curve, gives displacement of the body. It is because:

Area enclosed under the graph = Velocity × Time
= Displacement

(a) When velocity-time graph is parallel to the timeaxis.

As the graph is a straight line, therefore its ***Slope is zero***. Hence, its ***acceleration is zero***.
The distance covered by the body in a specified direction, i.e., displacement can be calculated by calculating the area of rectangle PQRS.
Thus,
Displacement = Area of rectangle PQRS
= PS × SR

(b) When velocity-time graph is a straight line, but not parallel to anyaxis.

The velocity-time graph CA for a body, such that starting from rest, its velocity increasing at a uniform rate.
The acceleration of the body can be calculated by finding the slope of the graph lineCA.
The acceleration of the body can be calculated by calculating the slope of the graph line CA.

(c) When velocity-time graph is a curve.

The velocity in this graph is variable and so is acceleration.
The acceleration at any point can be calculated from the slope of the curve at that point.
The distance covered (displacement) can be calculated by finding the area under the velocity-time curve.

Conclusions which can be drawn from the velocity – time graphs

1. When the velocity-time graph line is parallel to the timeaxis.
   (a) The body is moving with a uniformvelocity.
   (b) The acceleration of the body iszero.
   (c) The displacement can be calculated from the area under the graphline.
2. When the velocity-time graph is a straight line, but not parallel to anyaxis.

(a) The body is moving with a variablevelocity.
(b) The body has a uniform acceleration. The acceleration can be calculated from the slope of thegraph.
(c) The displacement can be calculated from the area under the graphline.
(d) If the slope of the graph is positive, then the body has a positive acceleration. However, if the slope is negative, then a body has a negative acceleration or retardation.

3. When the velocity-time graph is acurve.
   (a) The body has a variable velocity and a variableacceleration.
   (b) The area under the curve represents thedisplacement.
   (c) The acceleration at any instant can be calculated by finding the slope of the curve at thatpoint.

TO PROVE GRAPHICALLY

(i) $v = u + at$

(ii) $S = ut + \frac{1}{2}at^2$

(iii) $V^2 - u^2 = 2as$

Fig. (j) In velocity-time graph OA represents the initial velocity *u*, OC represents the final velocity v, such that the change in velocity is represented by AC or BE, which takes place in time t represented by OD orAE.

(i) **To prove** $v = u + at$

We know, Acceleration = Slope of the graph line AB

$$= \frac{BE}{AE} = \frac{BD - ED}{AE}$$

or $$a = \frac{v - u}{t} \quad \begin{bmatrix} BD = v, ED = u \\ AE = t \end{bmatrix}$$

or $$v - u = at$$

or $$v = u + at$$

(ii) **Toprove** $S = ut + \frac{1}{2}at^2$

Distance traveled = Area of trapezium ABDO

$$S = \frac{1}{2}(OA + BD)OD$$

$$S = \frac{1}{2}(u + v)t$$

$$S = \frac{1}{2}(u + u + at)xt$$

$$\{\because v = u + at\}$$

$$S = \frac{1}{2}(2u + at)xt$$

$$S = \left(u + \frac{at}{2}\right) x t$$

$$S = ut + \frac{1}{2} at^2$$

(iii) Toprove $V^2 - u^2 = 2as$

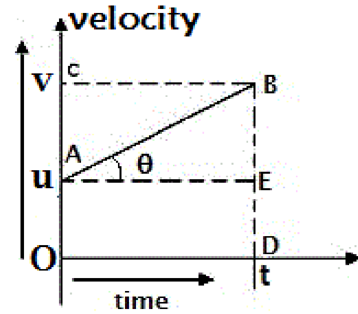


Figure (j)

Distance = area of trapezium OABD

$S = \frac{1}{2}$(sum of parallel sides)× height

$S = \frac{1}{2}(OA + DB) \times t$

$S = \frac{1}{2}(u + v) \times t$ →(i)

Now, $t = \frac{v - u}{a}$ [From equation 1] → (ii)

Therefore from (i) and (ii), we get

$$S = \frac{1}{2}(v + u)\frac{(v - u)}{a}$$

$$S = \frac{v^2 - u^2}{2a}$$

$$2as = v^2 - u^2$$

Or $v^2 - u^2 = 2as$

DERIVATION OF EQUATIONS OF MOTION BY DIRECT METHOD

IST EQUATION $v = u + at$

We know acceleration is change in velocity per unit time

$$a = \frac{\text{final velocity} - \text{initial velocity}}{\text{time taken}}$$

$$a = \frac{v - u}{t}$$

on transposing we get

$v = u + at$

2nd equation of motion

$S = ut + \underline{1at^2}$

2

we know distance covered = average velovity × time taken

$$V_{avg} = \frac{u+v}{2}$$

$$S = \frac{(u + v)}{2} \times t$$

From istequation of motion we have v = u +at, substituting the value in above equation weget

$$S = \frac{(u + u + at)}{2} \times t$$

$$S = \frac{(2u + at)}{2} \times t$$

$$S = ut + \frac{1}{2} at^2$$

-

3^{rd} equation of motion

$V^2 - U^2 = 2as$

As we already know distance travelled is equal to product of average velocity and time

$$V_{avg} = \frac{u+v}{2}$$

$$S = \frac{(u + v)}{2} \times t$$

From istequation of motionwehave v = u +at

Therefore $t = \frac{v - u}{a}$

put the value of 't' in above equation we get

$$S = \frac{(u + v)}{2} \times \frac{v - u}{a}$$

Using $a^2 - b^2 = (a + b)(a - b)$

$$S = \frac{v^2 - u^2}{2a}$$

$$V^2 - U^2 = 2as$$

CIRCULAR MOTION

The motion of a body around a circular path with a uniform speed is called circularmotion.

The direction of motion keeps changing in uniform circular motion.

If the radius of the circular path is r, then in one round the distance travelled by a body is equal to the circumference of the circle. If 't' is the time taken for completing one round and if 'v' is the constant speed with which the body is moving, then

$$V = 2\square r/t$$

Examples of circular motion

1. A stone tied to a thread and whirled in a circularpath.
2. Wheels of various vehicles rotating about theiraxles.
3. A satellite moving around the Earth in a circular path, at constantspeed.
4. The Moon revolving around the Earth in a circular path at constantspeed.

NUMERICALS

Question1.

An athlete completes one round of circular track of diameter 200 m in 40 sec.

What will be the distance covered and the displacement at the end of 2 minutes 20 sec?

Answer:

Time taken = 2 min 20sec = 140sec.

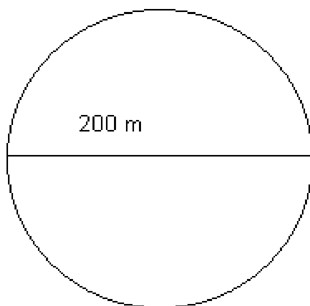
Radius r = 100m.

In 40 sec the athlete complete one round.

So, in 140sec the athlete in 140sec = (2 π r) x(3.5) = 2x (22/7) x 100x 3.5=2200m.

At the end of his motion, the athlete will be in the diametrically opposite position.

- Displacement = diameter =200m



A circular track

Question2.

Joseph jogs from one end A to another end B of a straight 300 m road in 2 minutes and 30 sec and

then turns around and jogs 100 m back to point C in another 1 minute.

What are Joseph's average speeds and velocities in jogging (a) from A to B (b) from A to C?

Answer:

(a) For motion from A to B:

Distance covered = 300 m

Displacement = 300 m.

Time taken =2min 30sec = 170 sec.

We know that, Average speed = (Total distance / Total time taken)

= (300 m/ 170 sec) = 1.7625 ms^{-1}
Average velocity = (Net displacement / time taken)

= (300 m/ 170 sec) = 1.7625 ms^{-1}

(b) For motion from A to C:

Distance covered = (AB+ BC) = 300 + 100 = 400 m.

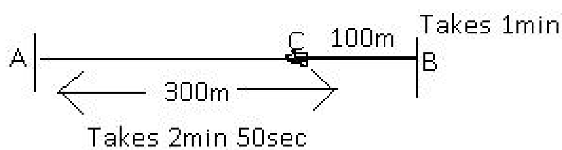
Displacement = AB - CB = 300 - 100 = 200 m.

Time taken = 170 sec + 60sec = 230 sec.

Therefore, Average speed = (Total distance / Total time taken)

= (400 / 230) = 1.739 ms^{-1}
Average velocity = (Total displacement / time taken) = (300-100)/ (230sec)

= (200 m / 230 sec) = 0.87ms^{-1}



Question 3.
Abdul, while driving to school, computes the average speed for his trip to be 20 kmh^{-1}.On his return trip along the same route, there is less traffic and the average speed is 40 kmh^{-1}. What is the average speed of Abdul's trip?

Answer:

From Home to school:-

Distance = d

Time taken $=t_1$
Average Speed = 20 kmh^{-1} = (d/t_1)

- $t_1 = (d/20)$ ------(1)

From School to Home:-

Distance = d

Time taken $=t_2$
Average Speed = 40 kmh^{-1} = (d/ t_2)

- $t_2 = (d/40)$ ------(2)

Therefore net avg. speed = $(2d)/ (t_1 + t_2) = (2d) / ((d/20) + (d/40))$
= (2d)/ (3/40) = (80/3) = 26.67m/s.

Question 4.

A motor boat starting from rest on a lake accelerates in a straight line at a constant rate of 3.0 ms^{-2} for 8.0 s. How far does the boat travel during this time?

Answer:

Initial velocity (u) = 0m/s

Acceleration= 3m/s^{-2}
Time (t) = 8 sec

We know that

Therefore, Distance covered (s) = $ut+ (1/2) at^2$

- $s=0 \times 8 + (1/2)\, 3m/s^2 \times (8s)^2$
- $s = (1/2) \times 3 \times 64m$
- $s = 3 \times 32m$
- s = 96m.

Therefore, boat travel a distance of 96 m in the given time.

Question 5.

A driver of a car travelling at 52 km h^{-1} applies the brakes and accelerates uniformly in the opposite direction.
The car stops in 5 s. Another driver going at 3 km h^{-1} in another car applies his brakes slowly and stops in 10 s.
On the same graph paper, plot the speed versus time graphs for the two cars. Which of the two cars travelled farther after the brakes were applied?

Answer:

For First Driver,

Initial velocity (u) = 52 km h^{-1}
= (52x 1000m)/ (60 x 60s) = 14.4 ms^{-1}
Time, t = 5s.

Final velocity v = 0 (As car stops).

For Second Driver,

Initial velocity u = 3 km h^{-1}
Distance s = (3000m)/ (60x 60 s) = 9.4 ms^{-1}
Time taken t = 10s

Final velocity v =0.

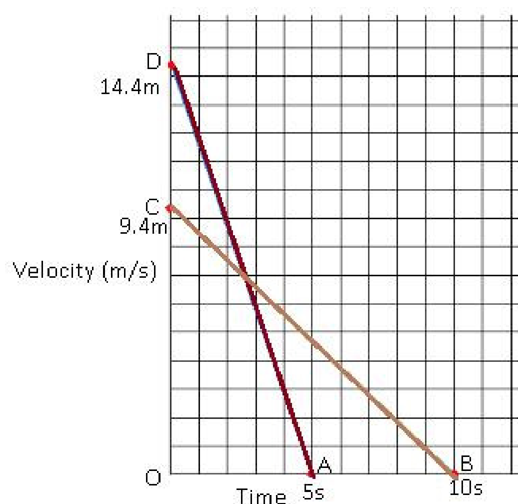
Distance is calculated by the area under the slope of the graph.

- Distance s = (1/2) x OA X OD
- = (1/2) x 14.4 x5
- s = 7.2m/s x 5s = 36m.

Distance covered by 2nd car = area of triangle (OBC)
Distance, s = (1/2) x OC x OB

- s = (1/2) x 9.4m/s x 10s
- s= 4.7m/s x 10s = 47m

Therefore, second car travelled farther.



In the graph, dark brown slope shows the velocity of the first car and light brown slope shows the velocity of the second car.

Question 6.

Fig 8.11 shows the distance-time graph of three objects A, B and C. Study the graph and answers the following questions:

(a) Which of the three is travelling the fastest?

(b) Are all three ever at the same point on the road?

(c) How far has C travelled when B passes A?

(d) How far has B travelled by the time it passes C?

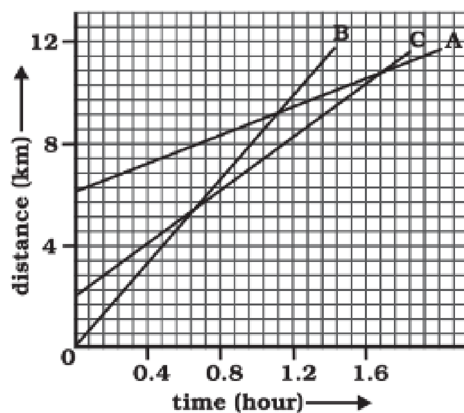


Fig. 8.11

Answer:

- It is clear from graph that B is covering more distance in less time. Therefore, B is the fastest.
- All of three are never at the same point at the same time on the road.
- According to graph; each small division shows about 0.57 km.

A is passing B at point S which is in line with point P and shows about 9.14km.

Thus at the point C travels about = 9.14 – 2.1375km=7km.

Thus, when A passes B, C travels about 7km.

(d) B passes C at point Q at the distance axis which is

= 4km + (0.57x2.25) =5.28km.

Question 7.

A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of $10ms^{-2}$,with what velocity will it strike the ground? After what time will it strike the ground?

Answer:

Given, Initial velocity u =0

Distance s = 20m

Acceleration a = $10 ms^{-2}$

- We know that $v^2 = u^2 + 2as$

=> $v^2 = 0 + 2x\ 10m/s^2\ x\ 20m$
=> $v^2 = 400\ m^2\ s^{-2}$
=> $v = \sqrt{400\ m^2\ s^{-2}}$
=> $v = 20ms^{-1}$
(b) We know that, v = u + at

=> $20ms^{-1} = 0 + 10ms^{-2} x\ t$
=> $t = (20ms^{-1} / 10ms^{-2}) = 2s$
Therefore, Ball strikes the ground at the velocity of $20ms^{-1}$.
Time taken to reach the ground = 2s.

Question 8.

The speed-time graph for a car is shown is Fig. 8.12.

(a) Find how far the car travels in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period.

(b) Which part of the graph represents uniform motion of the car?

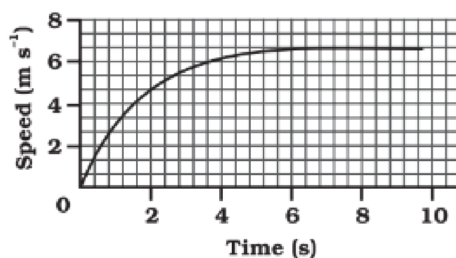


Fig. 8.12

Answer:

- Distance covered = area under slope of the speed – time graph.

In the given graph 56 full squares and 12 half squares come under the area slope for the time of 4s.

Total number of squares = 56 + (12/2) = 62 squares.

The total area of the squares will give us the distance travelled by the car in 4s.

On X-axis (time) = 5 squares = 2s

Therefore 1 square = (2/5) s

On Y-axis (speed) = 3 squares = 2m/s

Therefore 1 square = (2/3) m/s

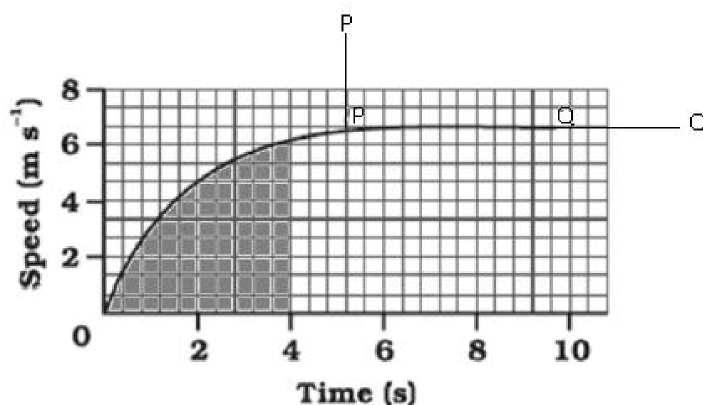
Therefore area of 1 square = (2/5) s + (2/3) m/s = (4/15) m

Therefore area of 62 squares = (4/15) m x 62

= (248/15) m = 16.53 m

Therefore car travels 16.53m in first 4 sec.

- MN of the slope of the graph is a straight line parallel to x-axis, thus it represents the uniform motion of the car.



Question 9.

State which of the following situations are possible and give an example for each of these:

(a) an object with a constant acceleration but with zero velocity

(b) an object moving in a certain direction with an acceleration in the perpendicular direction.

Answer:

- A body can have constant acceleration even when its velocity is 0. When a body is thrown up, at the
- highest point its velocity is 0 but it has acceleration equal to acceleration due to gravity.
- Yes, acceleration which is moving in horizontal direction is acted upon by the acceleration due to gravity that acts
- vertically downwards. In case of circular motion, when an object moves on a circular path, its direction is
- along the tangent of the circle but the acceleration is towards the radius of the circle.
- And tangent always makes a right angle with the radius, so in circular motion acceleration and velocity are mutually perpendicular to each other.

Question 10.

An artificial satellite is moving in a circular orbit of radius 42250 km. Calculate its speed if it takes 24 hours to revolve around the earth.

Answer:

Radius = 42250km = 42250000m

Time t =24h = 24 x 60 x 60 s

Using Speed $v = (2 \pi r)/(t)$

= (2 x 3.14 x 42250000) / (24 x 60 x 60) m/s

=3070.9 m/s = 3.07 km/s.